

Phytoremediation Pilot Study Summary Report

Wetland Area

Dayco Corporation/L.E. Carpenter Superfund Site, Wharton, New Jersey

February 2017

Prepared For L.E. Carpenter & Company

Grant Wilsterman Project Engineer

Barrett E. Culp, P.G.

Senior Project Manager

Robert W. Hanley, Ph.D. Senior Consultant

Karen C. Saucier, Ph.D. Project Coordinator

TRC Environmental Corporation | Dayco Corporation/L.E. Carpenter Superfund Site Phytoremediation Pilot Study Summary Report

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Section 1 Introduction

This report summarizes phytoremediation pilot study activities conducted in the Wetland Area (aka MW-30 Area) of the Dayco Corporation/L.E. Carpenter (LEC) Superfund Site (Site) in Wharton, New Jersey.

1.1 Site Background

The Site is a former manufacturing facility located at 170 North Main Street, Wharton, New Jersey. Commencing in the early 1980s, NJDEP conducted sampling of wastes and water at the Site. These investigations detected volatile organic compounds and metals. In addition, light non-aqueous phase liquid (LNAPL or floating product) was observed floating on the groundwater table. In 1982, LEC and NJDEP entered into an Administrative Consent Order (ACO), in which LEC agreed to excavate waste and decontaminate groundwater.

In April 1985, the United States Environmental Protection Agency (USEPA) placed the Site on the National Priorities List, and in September 1986, NJDEP and LEC entered into an amended ACO to conduct a Remedial Investigation/Feasibility Study (RI/FS) at the Site. LEC conducted the RI/FS from 1986 to 1993, and in 1995 USEPA issued a Record of Decision (ROD), selecting a remedy to address the areas of concern at the Site (USEPA, 1995). USEPA assumed the lead enforcement role for the Site in 2009, at which time the 2009 Unilateral Administrative Order (UAO) was issued to LEC by the USEPA (effective August 6, 2009). The UAO directed LEC to undertake the cleanup of limited residual soil hot spot areas (discovered during post-remedy groundwater monitoring) and continue a natural attenuation groundwater study that was being conducted at the Site.

The September 2009 Remedial Action Work Plan (RAWP) Addendum outlined a scope of work focused on completion of Section I.A.1 of the SOW. Specifically, the scope of work included:

- Implementing a 1994 ROD approved soil remedy at the MW19HS1 residual source area.
- Further delineation of the nature and extent of residual source mass in the MW-30 Area.
- Initiating a groundwater biodegradation pilot study in the MW-30 Area.

The MW19HS1 activities set forth in the 2009 RAWP Addendum are substantially complete and were documented in a Remedial Action Report (RAR) Addendum dated July 2010. Additionally, the nature and extent of residual mass within the Wetland Area was assessed as part of the Supplemental Remedial Investigation (RI) that was conducted during the fourth quarter of 2011. A bench-scale treatability study and literature review was performed on soil samples collected from the Wetland Area to assess the best options for source mass reduction. It was determined that many of the active remedial options perform similarly but are costly to

operate. In order to achieve an effective and sustainable remedial solution, and in consideration of USEPA's Green Initiative, it was determined that a phytoremediation remedy could effectively reduce Site COCs in groundwater and soil while encouraging a natural biologic/hydraulic barrier to flow toward the Rockaway River.

1.2 Pilot Study Background

Activities to further evaluate the potential for residual source areas in the Wetland Area (*i.e.*, the MW-30 Area) and initial pilot testing to evaluate remediation of residual dissolved bis 2-ethylhexyl-phthalate (DEHP) along with benzene, toluene, ethylbenzene, and xylenes (BTEX) were originally presented in the RA Work Plan Addendum (RMT, 2009). USEPA provided comments on the RA Work Plan Addendum in an email dated December 21, 2009. Responses to the MW-30 Area specific comments were submitted to the USEPA on February 1, 2010 and approved by USEPA in their email dated February 22, 2010.

The revised RA Work Plan Addendum (TRC, July 2011; revised October 2011) set forth a supplemental investigation in the Wetland Area to:

- Further characterize and delineate dissolved-phase organic COCs in groundwater;
- Identify potential residual source area(s) of organic COCs that could result in discharges to the drainage ditch or the Rockaway River;
- Determine whether Site related contaminants from the remaining residual source area(s), if any, are impacting the wetland both within and/or outside the potential remaining source Area of Concern; and
- Characterize the rate and cause of concentration declines observed in the Wetland Area monitoring wells.

The data collected from the Wetland Area focused RI, as presented in the MW-30 Remedial Investigation (RI) Summary and Bench-scale Treatability Study Results (TRC, April 26, 2012), were used to further characterize and delineate potential free-phase residual organic COCs in soils and dissolved-phase organic COCs in groundwater. Based on the results of the focused remedial investigation and subsequent bench scale study, TRC recommended that a phytoremediation solution be further evaluated for the Wetland Area. This recommendation was based on the fact that a properly designed phytoremediation remedy would encompass several degradation and attenuation mechanisms which often occur simultaneously:

- Removal
- Degradation
- Sequestration
- Hydraulic control

More specifically, the phytoremediation mechanisms that could influence remediation of DEHP and BTEX constituents in soil and groundwater in the Wetland Area include:

- Rhizofiltration (Removal) It is anticipated that a phytoremediation remedy, through physical uptake, could function to reduce migration of groundwater to surface water in focused areas along the Rockaway River and the Eastern Drainage Ditch.
- Rhizodegradation (Degradation) –Biological degradation of BTEX and DEHP would be enhanced in the active microbial environment around a healthy root zone.
- Phytostabilization (Sequestration) DEHP, and to a lesser extent, BTEX constituents would be immobilized in the relatively high organic carbon environment represented by a healthy root zone.

Further, a phytoremediation solution was determined to be highly consistent with and protective of land and ecosystem use within the wetland portion of the Site. A phytoremediation solution minimizes total energy use and maximizes use of renewable resources.

1.3 Purpose and Scope of Phytoremediation Pilot Study

The purpose of this Phytoremediation Pilot Study Summary Report is to document the in-field pilot evaluation of the effectiveness of phytoremediation as a remedial option. Effectiveness is a function of reduced COC concentrations in soil and groundwater. Effectiveness of the phytoremediation pilot study can be assessed by an enhanced biological attenuation/remediation zone and the potent to influence the localized flow dynamics between the residual source material within the Wetland Area and the Rockaway River and the Eastern Drainage Ditch (EDD).

Section 2 Phytoremediation Pilot Study Installation

The in-field pilot study to assess the viability of phytoremediation to reduce COCs in groundwater and soil in the Wetland Area of the Site in Wharton, New Jersey was initiated in March 2013. This section documents the installation component of the phytoremediation pilot study.

2.1 Pre-Design Data Gathering

Prior to mobilizing to the Site, TRC conducted the following pre-design data gathering activities to support the pilot scale activities.

2.1.1 Pilot Study Access

The pilot study area is located within the Wetland Area on an adjacent property owned by Wharton Enterprises. L.E. Carpenter reached an agreement with the property owner of Wharton Enterprises to expand the existing access agreement to include installation of the phytoremediation pilot study. An indeterminate access duration for sampling continues under the original agreement, but the addendum provided for a two year duration to enable phytoremediation installation activities and this allowed an expansion of the initial phytoremediation plantings to maximize remedy influence during the agreement term. Figure 2-1 illustrates the location of the phytoremediation pilot study area relative to other Site features.

2.1.2 NJDEP Permit Review

TRC reviewed the existing wetland permit, GP-4 land use permit and flood hazard permit to confirm their applicability, and held a discussion with NJDEP to confirm that the existing permits were sufficient and/or no additional permits were required. The Site is a National Priorities List (NPL) site under federal jurisdiction. As such, state and local permits are not required for completion of remedial activities for work conducted on the Site. The substantive technical considerations inherent in the applicable regulations were addressed during remedy implementation.

2.1.3 Agronomic Assessment

TRC conducted an agronomic assessment to determine baseline water quality in the Wetland Area relative to factors that are potentially inhibitory or toxic to trees. Field efforts included the collection of shallow groundwater samples from three wetland

monitoring wells (MW-32s, MW-34s, and MW-35s) that were submitted to an agrochemical laboratory for analysis of key indicator parameters, including:

- Nitrate-nitrogen values greater than 30 milligrams per liter (mg/l) can cause excessive growth;
- Total dissolved solids indicator of high inorganic ion content;
- Chloride values greater than 700 mg/l can inhibit growth in salt sensitive species;
- Alkalinity values greater than 150 mg/l can inhibit growth;
- Sulfate values less than 50 mg/l may inhibit growth;
- Sulfur used to determine amount of sulfur present in forms other than sulfate;
- Sodium adsorption ratio (SAR) Adjusted SAR (SARa) values greater than 13 indicate potential high sodium levels;
- Calcium (Ca) and Magnesium (Mg) if ratio of Ca/Mg is less than 1, there is a
 potential for calcium deficiency;
- Sodium -
 - percent of cations above 60 percent inhibits salt sensitive crops,
 - highly variable, influenced by presence of other ions, values of 70 mg/l could potentially cause some problems;
- Potassium non-toxic, essential nutrient; and
- Boron can become toxic at concentrations between 1 to 5 mg/l.

Table 2-1 presents the results of the agronomic assessment of water sampled from monitoring wells MW-32s, MW-34s and MW-35s. The evaluation concluded that the Site water represented excellent agricultural water with a very low salinity hazard and was therefore supportive of phytoremediation plantings. Analytical reports for agronomic assessments of water quality are included in Appendix A.

2.2 System Layout and Design

The pilot study layout was designed in such a way as to have influence on the radial flow of groundwater from the Wetland Area to the south toward the Rockaway River and to the north toward the Eastern Drainage Ditch. The final Wetland Area phytoremediation pilot study design called for installing 51 trees. Figure 2-2 presents the layout of trees planted for the phytoremediation pilot study.

Based on historical monitoring data and the results of the Supplemental RI, the impacted level in the Wetland Area is between 7 and 15 feet below ground surface. In order to encourage root

growth in deeper zones and root zone hydration through groundwater rather than infiltrating rainwater, a root management system called TreeWell® was used for installation of the pilot study. The TreeWell® system is effective in constraining propagation of shallow root systems and encouraging tree root growth downward to the water table. A schematic cross section of a TreeWell® System is presented in Figure 2-3.

Within the southern portion of the Wetland Area near the Rockaway River, 36 trees were planted in three rows. Two rows were planted south of monitoring wells MW-33 and MW-34, and a third row was planted north of these monitoring wells. An additional 15 trees were planted in the northeastern portion of phytoremediation pilot study area, on the boundary of the Wetland Area and the EDD. In general, the trees were planted on 12 to 15-foot centers, which was intended to achieve overlapping root growth across the pilot study area. The trees were planted perpendicular to groundwater flow. Upon maturity, the trees are intended to act as a phytoremediation barrier to enhance degradation/attenuation and influence localized groundwater flow between the Wetland Area and the Rockaway River and Eastern Drainage Ditch.

It is anticipated that the phytoremediation barrier will be effective within two years of planting. As noted in Section 1, phytoremediation can positively influence Site conditions in a healthy root zone through mechanisms of rhizofiltration (removal), rhizodegradation, and phytostabilization (sequestration). Assuming limited to no toxic effects from Site COCs on the trees, phytoremediation plantings can be effective in excess of thirty years.

2.3 Tree Species Identification

TRC reviewed the historical wetlands monitoring and mitigation reports and identified tree species suitable for the Site conditions and remedy objectives. The following is a list of the screening criteria that were used to determine the appropriate trees for installation in the Wetland Area.

- Species compatible with climate at the project location
- Species that are site appropriate with respect to soil type, slope, soil moisture, etc.
- Species available from local or regional source in sufficient numbers
- Species exhibiting required root physiology characteristics (depth to target zone, etc.)
- Species possessing other cultural or recreational value (habitat enhancement, etc.)
- Species fast growing and that will enhance appearance of the area
- Species that are very hardy and can tolerate root zone submergence
- Species available as four or five year old planting (approx. 6 feet high)
- Species known for high water use and shorter dormancy period species preferred

Two different species of trees that fit these criteria, river birch (*Betula nigra*) and weeping willow (*Salix babylonica*), were planted for the phytoremediation process in the Wetland Area. The trees were purchased locally as four to five year-old saplings and were received in 10--gallon containers. Of the 36 trees planted near the Rockaway River, 21 were river birch and 15 were weeping willows. Of the 15 trees planted near the Eastern Drainage Ditch, 5 were river birch and 10 were weeping willows.

2.4 System Installation

Installation of the phytoremediation system included mobilization, site preparation, installation of 51 TreeWells® and trees, tree trunk protection, and management of investigation-derived waste. Photographs of the pilot study installation are included in the photographic log in Appendix B.

2.4.1 Site Mobilization and Preparation

As part of the site mobilization and preparation activities, TRC identified the activities requiring subcontractor support. Equipment and material contractors were selected and pre-qualified as part of the mobilization activities. In addition, the New Jersey One Call system was notified prior to mobilization to locate and mark in the field underground utilities in the area of planting.

TRC mobilized the necessary personnel, equipment, and materials to the Site. Locations for individual TreeWell® installations and the species to be planted at each location were marked in the field.

2.4.2 Borehole Installation

The field installation plan called for using an 18-inch, hollow stem auger to advance 1.5 to 2-foot diameter boreholes to a target depth of 8 to 10 feet at each of the planting locations. Due to the presence of a cobble layer underlying the Wetland Area, the 18-inch auger was not able to achieve the target depth. An alternate method for advancing the boreholes was attempted and also proved unsuccessful. In the end a mini excavator was mobilized to the Site to clear cobbles from each of the locations. After clearing the cobbles, multiple passes with a 6-inch solid stem auger were used to create the planting boreholes at each location.

2.4.3 Planting Method

A total of 51 TreeWell® System trees were planted. The trees were four to five years old at the time of planting. The final TreeWell® installation locations are depicted on

Figure 2-4. Tree locations were adjusted to accommodate existing established trees, and other obstructions. The boreholes were lined to a depth of approximately 8 feet below grade, to intersect the interval of highest observed COC concentrations. The casing material was galvanized iron, plastic piping, or plastic casing. An aeration tube was installed to the bottom of the hole and extended to 2 feet above the hole. The hole was backfilled with topsoil to 2 or 3 feet below ground surface (fbgs). A slow release commercial fertilizer was added at a rate of ½ lb. of 13-13-13 (N-P-K) fertilizer per location. Water was added to the backfilled soil to settle the soil and remove air pockets. The tree was then placed in the center of the borehole and the roots covered with additional topsoil. The loose friable backfill was worked around the roots and thoroughly settled with water to insure good root/soil contact. Care was taken to avoid bruising or breaking the roots. Soil was slightly mounded around the tree to minimize surface water flow into the tree borehole and to avoid surface water ponding. Coarse material backfill was then added to bring the borehole to approximately 1 foot above grade.

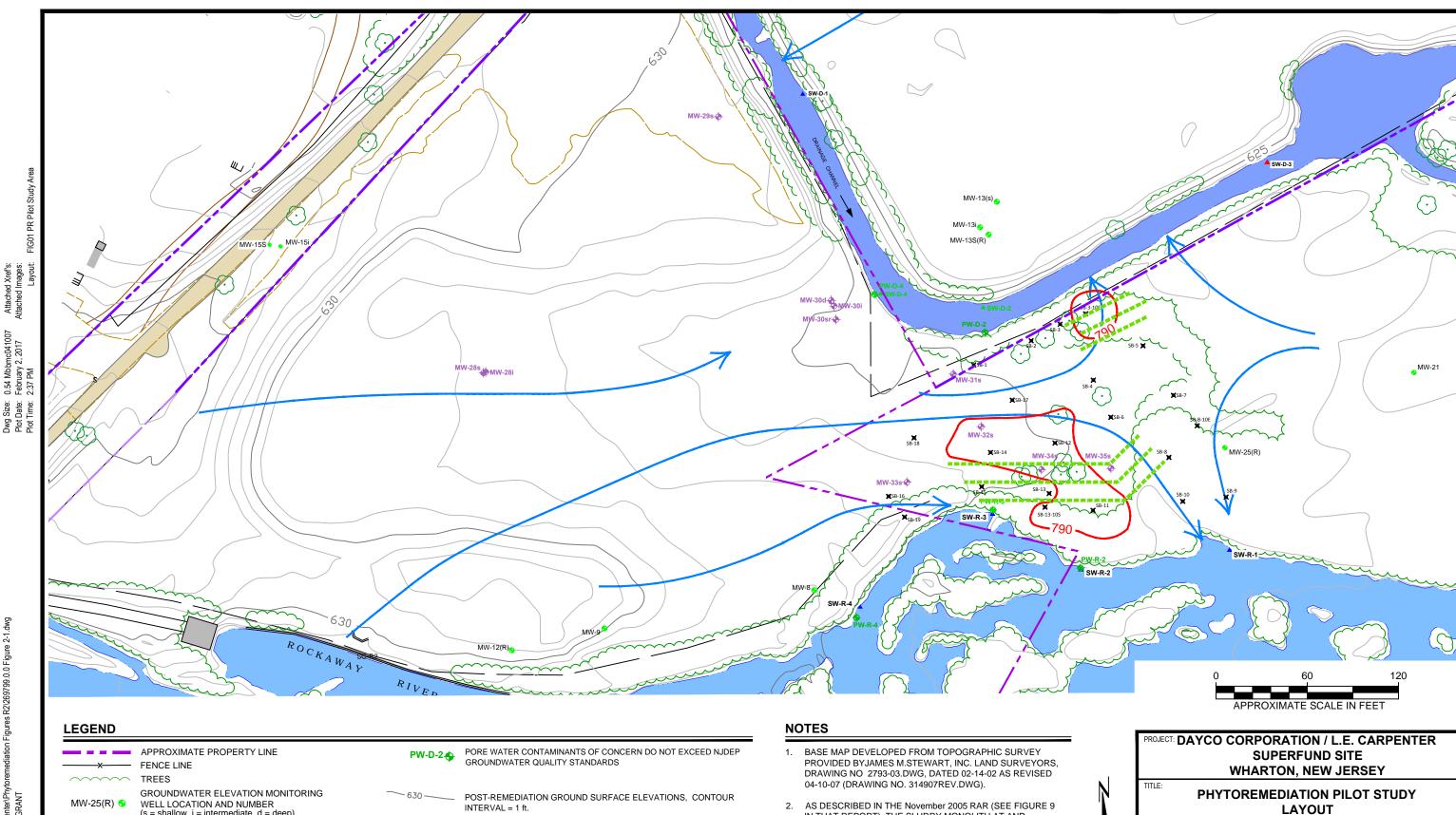
2.4.4 Tree Trunk Protection

To reduce tree loss due to damage from herbivores such as white-tail deer, the newly installed trees were protected by use of a plastic collar placed around the trunk from the ground surface to a minimum of 2 to 3 feet above the base of the tree. Wire, metal bands, or other material for this purpose that could damage or injure the trees were not used.

2.5 Site restoration

Upon completion of planting activities, the disturbed area around each TreeWell® installation was smoothed and ruts and/or indentations caused by equipment were filled in to prevent further erosion. Sediment and storm water control devices installed prior to beginning the tree plantings remained in place until the subsequent monitoring period, during which time they were removed and disposed.

Site soil removed during installation was visually inspected for evidence of COCs. Excavated soils with no visible evidence of COCs were mixed with topsoil and used as planting media. Soils which were visually impacted were placed in a covered roll-off. Impacted soil was transported by a licensed contractor to the Michigan Disposal Waste Treatment Plant in Belleville, Michigan for proper offsite disposal.



MW-25(R) • WELL LOCATION AND NUMBER (s = shallow, i = intermediate, d = deep) MW-29s PRMP MONITORING WELL LOCATION AND NUMBER (s = shallow, i = intermediate, d = deep) SURFACE WATER SAMPLING LOCATION (D = DITCH; R = RIVER)SB-18 🙀 SOIL BORING LOCATION

PORE WATER CONTAMINANTS OF CONCERN EXCEED

PHYTOREMEDIATION PILOT STUDY AREA

PW-D-2
NJDEP GROUNDWATER QUALITY STANDARDS

ISOCONCENTRATION FOR BIS (2-ETHYLHEXYL) PHTHALATE (DEHP) (PPM) IN SOIL BORING SAMPLES (790 PPM = NJDEP IMPACT TO GROUNDWATER SOIL SCREENING LEVEL)

GROUNDWATER FLOW DIRECTION

- IN THAT REPORT), THE SLURRY MONOLITH AT AND PARALLEL TO THE DRAINAGE CHANNEL DITCH ENDS APPROXIMATELY 10 FEET WEST OF THE ACTUAL WATERS
- 3. OIL IN SOIL RESULT NOTES
 - N = NON-DETECT FIELD SCREENING KIT
 - Y = DIFFUSE OIL DETECTED IN FIELD SCREENING
- Y+ = PRODUCT DETECTED IN FIELD SCREENING KIT

| DRAWN BY | : SJL/DGS/ | GAW | SCALE: | PROJ. NO. | 269799.0.0 Phase 2 |
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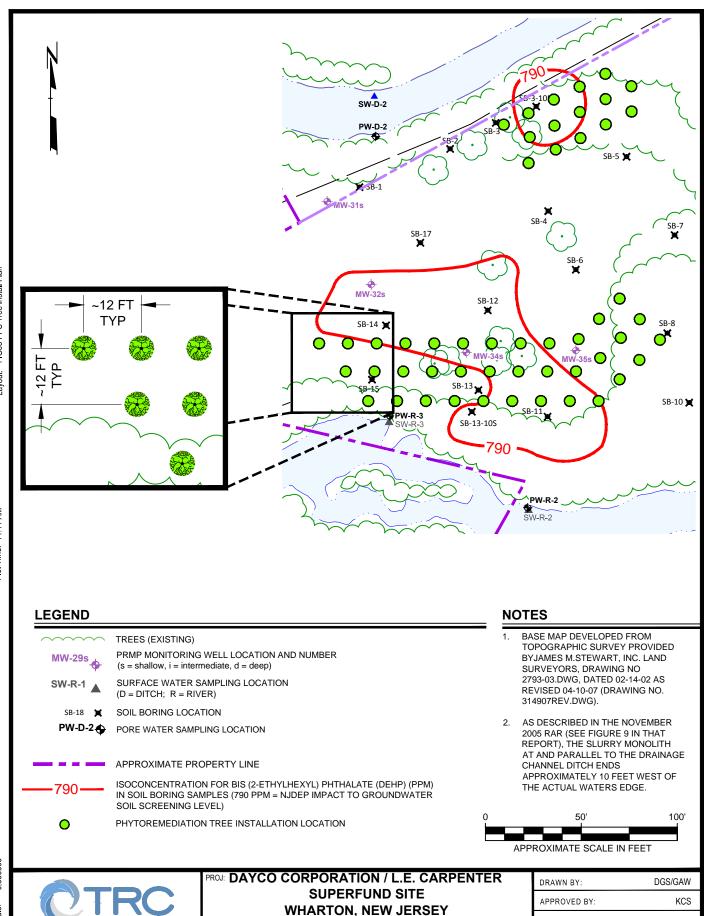
1540 Eisenhower Place Ann Arbor, MI 48108 Phone: 734.971.7080 Fax: 734.971.9022

Drawing Plot Scale: Operator Name: Drawing Name: PLOT DATA

1540 Eisenhower Place Ann Arbor, MI 48108

Phone: 734.971.7080

Fax: 734.971.9022



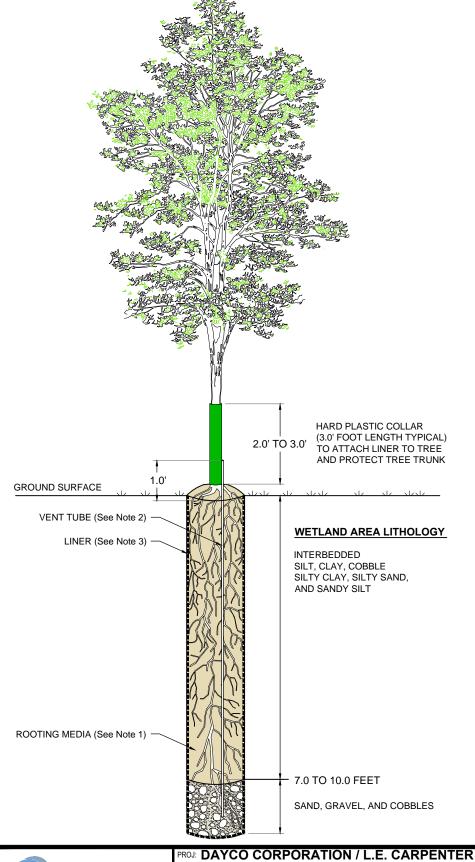
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Operator Name:
Drawing Plot Scale:

1540 Eisenhower Place Ann Arbor, MI 48108 Phone: 734.971.7080

Fax: 734.971.9022



NOTES

- ROOTING MEDIA IS A
 COMBINATION OF SITE SOILS
 AND TOPSOIL/POTTING SOIL
 WITH AMENDMENTS.
- 2. VENT TUBE IS A 2-INCH DIAMETER CORRUGATED SLOTTED DRAINAGE PIPE.
- LINER IS 6 MIL PVC OR ALTERNATIVE MATERIAL DEPENDING ON SITE CONDITIONS.

ROJ: DAYCO CORPORATION / L.E. CARPENTER SUPERFUND SITE WHARTON, NEW JERSEY

PHYTOREMEDIATION PILOT STUDY
TREE WELL® SCHEMATIC

 DRAWN BY:
 DGS/GAW

 APPROVED BY:
 KCS

 PROJ. NO.
 269799.0.0 Phase 2

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 269799.0.0 Figure 2-3.dwg

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 FEBRUARY 2017

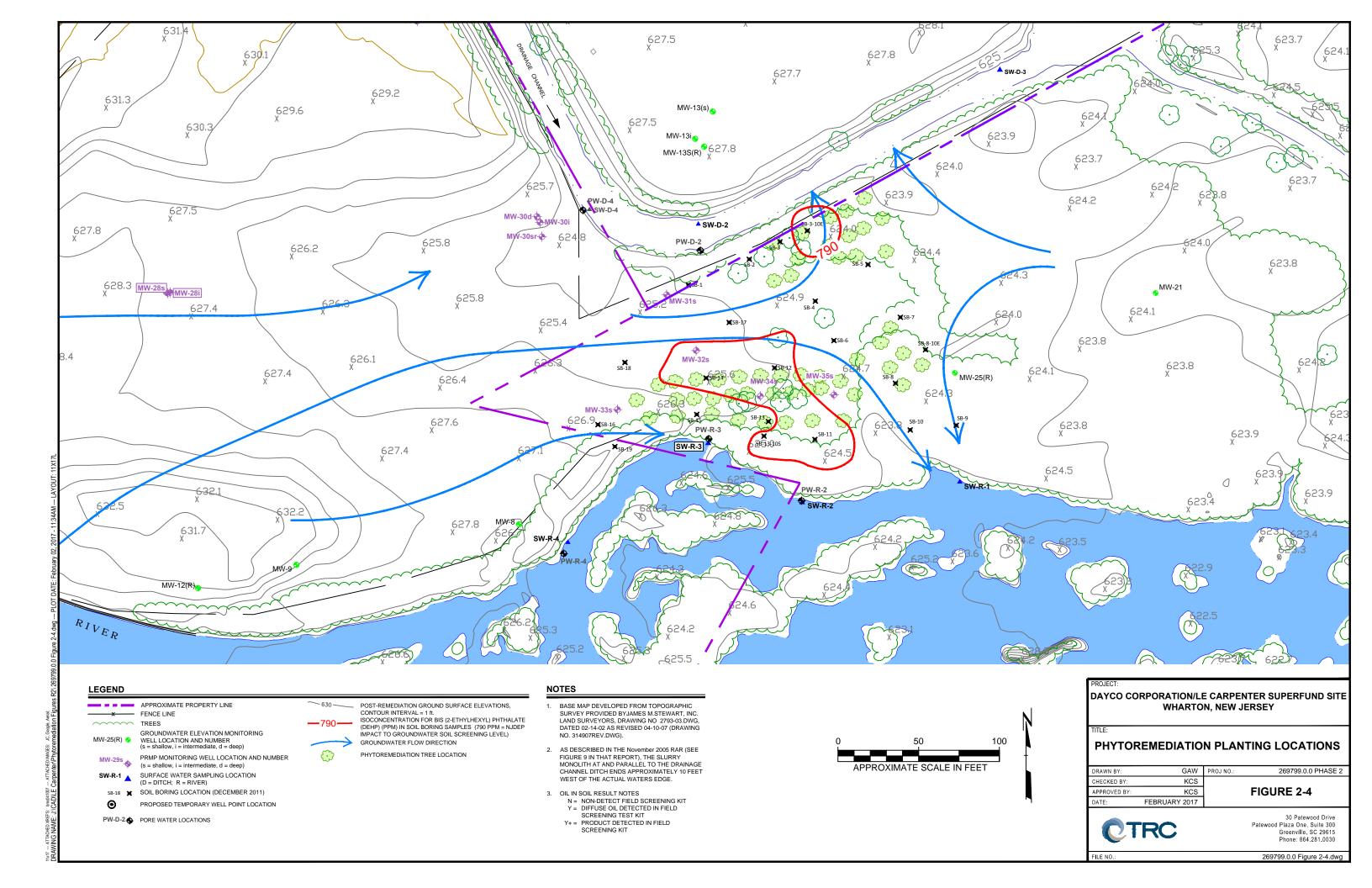


Table 2-1 **Baseline Groundwater Quality – Agronomic Parameters**

| PARAMETER (mg/L, unless otherwise noted) | OPTIMAL RANGE/VALUE | MW-32s | MW-34s | MW-35s |
|--|------------------------|--------|--------|--------|
| Nitrate+Nitrite Nitrogen, NO ₃ +NO ₂ -N | <30 | <0.2 | <0.2 | <0.2 |
| Chloride | <700 | 87.2 | 85.3 | 25.2 |
| Sulfate | >50 | 3.8 | 39.2 | 90.5 |
| Bicarbonate, HCO ₃ | <600 | 430 | 290 | 320 |
| Carbonate, CO ₃ | 3 to 10 | <10 | <10 | <10 |
| Total Alkalinity, CaCO ₃ | <150 | 350 | 230 | 260 |
| Total Calcium, Ca | <400 | 87 | 67 | 55 |
| Total Magnesium, Mg | <60 | 30 | 20 | 21 |
| Ca/Mg Ratio | >1 | 2.9 | 3.4 | 2.6 |
| Total Potassium, K | Essential nutrient | 3 | 3 | 2 |
| Total Sodium, Na | <70 | 34 | 19 | 46 |
| Sodium Adsorption Ratio, SAR (Ratio) | <13 | 0.8 | 0.5 | 1.3 |
| Adjusted SAR, SAR _a (Ratio) | <13 | 2.0 | 1.1 | 2.9 |
| Sodium Percentage (% of cations) | <60 | 17.7 | 14.0 | 30.7 |
| Total Boron, B | <1 | 0.1 | 0.08 | 0.09 |
| Total Iron, Fe | 5 to 20 | 14 | 31 | 12 |
| Total Manganese, Mn | 0.2 to 10 | 4.9 | 3.9 | 1.8 |
| Electrical Conductivity, EC (µmho/cm) | <3,000 | 909 | 747 | 729 |
| Total Dissolved Solids, TDS | <2,000 | 582 | 478 | 467 |
| pH (units) | 6.0 to 8.5 | 6.6 | 6.4 | 6.7 |

Consistent with optimal range/value for high quality agricultural water

Not consistent with optimal range/value for high quality agricultural water

2-10

Section 3 Performance Monitoring

This section presents the stages of performance monitoring conducted in the vicinity of the pilot study area within the Wetland Area following pilot installation in early 2013. The various phases of performance monitoring included:

- Well point water quality sampling
- Quarterly water quality monitoring
- Visual observations

3.1 Well Point Water Quality Sampling

In conjunction with the phytoremediation pilot, USEPA requested evaluation of water quality conditions downgradient of the pilot study area, between monitoring well MW-35 and the Rockaway River. Due to access limitations with tracked equipment and frequent flooding of the Rockaway River in that portion of the wetlands, installation of permanent monitoring wells was deemed not practicable. Therefore, it was agreed that temporary well points would be utilized to collect point-in-time groundwater samples from the shallow portion of the aquifer.

Two separate well point water quality sampling events were attempted in support of the phytoremediation pilot study. A baseline post-installation well point sampling of groundwater was completed during the 3Q13 monitoring event, and a second well point sampling event to assess groundwater in the phytoremediation pilot study area was completed in 4Q14.

3.1.1 3Q13 Well Point Water Quality Sampling Event

Consistent with a July 25, 2013 work plan, eight Solinst Model 615 stainless steel drive points were installed in the Wetland Area for collection of shallow groundwater samples. Figure 3-1 depicts the locations of these temporary well points. Well point installation was difficult due to large cobble encountered at 1 to 2 fbgs, and at several locations more than one well point had to be driven in order to reach the target sample depth.

On August 2, 3013, concurrent with the routine 3Q13 monitoring event, the eight temporary well points were sampled for DEHP and BTEX analysis. Temporary well points TW-35-2, TW-35-3, and TW-35-4 could not be sampled either because groundwater could not be recovered or well point refusal due to substrate interference was encountered before reaching the water table. TW-35-7 yielded insufficient groundwater for DEHP analysis, and the recovery rate was too slow to allow for slow

purge sampling. The 3Q13 well point results presented on Table 3--1 and summarized in the following narrative were initially reported in Progress Report 39 (TRC, 2013) and documented and discussed in the 2013 Second Semiannual Groundwater Monitoring Report (TRC, 2014).

Well point TW-35-5 exhibited the highest concentrations of DEHP and BTEX. This well point is within the Wetland Area and upgradient of the pilot study area. DEHP concentrations in TW-35-6 and TW 35-8, which are both hydrologically downgradient from TW-35-5, were two orders of magnitude lower than the DEHP result from TW-35-5.

While the results from the 3Q13 temporary well point sampling event provided suggestive evidence that phytoremediation will enhance the attenuation and degradation of DEHP and BTEX, a definitive conclusion is tempered by the inability to obtain shallow groundwater samples from four of the eight temporary well points, and poor recovery rates from the other temporary well points.

3.1.2 4Q14 Well Point Water Quality Sampling Event

Consistent with an October 20, 2014 revised work plan, TRC performed follow-up sampling of temporary well points in the pilot study area to further assess water quality in the Wetland Area in conjunction with the routine 4Q14 monitoring event. Figures 3-2 (a and b) depict the locations of these temporary well points. In addition to the well points in the vicinity of the pilot study, supplemental characterization of near-shore porewater, surface water and sediment were performed coincident with the routine 4Q14 event. The comprehensive multimedia data set was documented and discussed in the 2014 Second Semiannual Groundwater Monitoring Report (TRC, 2015).

Nine temporary stainless steel well points (3/4" Solinst Model 615S) were advanced on average 4 feet below ground surface in the pilot study area within the Wetland Area concurrent with the 4Q14 sampling event. Similar to the adjacent wetland monitoring wells, low recharge of groundwater was observed in many of the temporary well points. In locations where no groundwater could be obtained, the well points were relocated within the same vicinity in an attempt to collect groundwater. Multiple relocation attempts were made at each "dry" location. Even through these efforts, groundwater BTEX and DEHP samples could not be collected from five of the well points (TW-35-1, TW-35-5, TW-35-6, TW-35-7, and TW-35-8). DEHP samples could not be collected from one additional location (TW-35-4).

The 4Q14 well point results¹ are presented on Table 3-2 and Figures 3-2a (BTEX) and 3-2b (DEHP). BTEX constituents were not detected above the NJGWQC in any of the four samples collected from the temporary well point locations. Samples for BTEX analysis were not collected from five temporary well point locations due to insufficient purge volume. Groundwater samples collected from TW-35-2 exhibited DEHP concentrations above the greater of the NJGWQS and PQL. Elevated concentrations in this sample are likely due to turbidity of the sample collected from the temporary well, as the filtered aliquot of sample TW-35-2 did not contain DEHP above the NJGWQS and PQL. DEHP was below the NJGWQC in the other two samples able to be collected from temporary well point locations. Samples for DEHP analysis were not collected from five temporary well point locations due to insufficient purge volume.

The supplemental well point and pore water sample results, especially on consideration of filtered sample results, demonstrate that the extent of BTEX and DEHP are sufficiently delineated in the Wetland Area. Additionally, the low recharge observed in the near surface geology indicates that soil characteristics restrict horizontal migration of Site-related compounds in the Wetland Area. As the downgradient extent of BTEX and DEHP in the Wetland Area are likely coincident with the groundwater-surface water interface at the Rockaway River, additional groundwater investigations to delineate BTEX and DEHP in the wetland are not warranted.

3.2 Quarterly Water Quality Monitoring

Since the phytoremediation pilot study was installed in March 2013, the 2Q13 sampling event represented the first routine quarterly groundwater and surface water monitoring event following the pilot study. Eighteen quarterly events have subsequently been performed in the Wetland Area since the installation of the phytoremediation pilot study.

There are four monitoring wells in the vicinity of the phytoremediation pilot. Monitoring wells MW31s and MW-32s are immediately up gradient of the pilot study area. Monitoring well MW-34s is located within relatively tight spacing of phytoremediation plantings. Monitoring well MW-35s is located where planting spacing is slightly wider based on field conditions.

Since consistent quarterly monitoring for dissolved DEHP was initiated in 3Q15, all monitoring wells in the Wetland Area have displayed very low to non-detectable concentration of dissolved DEHP. Figures 3-3a and 3-3b present time versus concentration graphs for COCs (DEHP [total and dissolved] and BTEX) in monitoring wells MW-34s and MW-35s, respectively, from 1Q13 through the most recent quarterly sampling event, 4Q16. Figure 3-4 presents the total and

¹ Full analytical data reports were previously provided in 2014 Second Semiannual Groundwater Monitoring Report (TRC, 2015).

dissolved DEHP distributions from the most recent quarterly monitoring event held in 4Q16. Dissolved DEHP appears to be confined within the phytoremediation pilot footprint.

When compared to pre-pilot baseline trends, the time versus concentration graphs for MW-34s indicate an improved declining trend for total DEHP and observed BTEX compounds (ethylbenzene and xylene). For DEHP in MW-34s, dissolved DEHP has not been detected since installation of the pilot study and over 50 percent (ten of 18) of the quarterly samplings have displayed either non-detectable total DEHP or total DEHP concentrations below the New Jersey Ground Water Quality Standard (NJGWQS). The total DEHP trendline is approaching the NJGWQS. Ethylbenzene and xylene are generally observed below their respective NJGWQS in MW-34s, only three xylene and two ethylbenzene concentrations have been detected above their respective NJGWQS in the 18 quarterly sampling events following pilot study installation. The ethylbenzene and xylene trendlines are below their respective NJGWQS.

When compared to pre-pilot baseline trends, the time versus concentration graphs for MW-35s indicate an improved declining trend for total DEHP. However, the trends for observed BTEX compounds (ethylbenzene and xylene) are not materially changed from pre-pilot trends. For DEHP in MW-35s, dissolved DEHP is not detected or below the NJGWQS in five of seven samples. Total DEHP concentrations remain above the NJGWQS, but have declined over an order of magnitude since installation of the phytoremediation pilot. Ethylbenzene and xylene are generally observed above the NJGWQS in MW-35s, however three of 18 quarterly sampling events did result in ethylbenzene and xylene observations below the NJGWQS.

In summary, in areas of more tightly spaced phytoremediation plantings, the groundwater quality is markedly improved over pre-pilot baselines.

3.3 Visual Observations

Annual wetland monitoring and reporting was conducted at the Site as a component of previous source reduction activities in the wetland. The wetland biologist performed a spring Site visit on May 21-22, 2013 followed by a thorough review of the mitigation site on September 5, 2013. The following observations related to the pilot study area were included in the 2013 Compensatory Mitigation Monitoring Report (Cardno JFNew, 2013).

The pilot study included the installation of 51 trees along the south edge of the forested zone and north edge of the emergent zone within the wetland mitigation area. The species planted were a combination of river birch (Betula nigra) and weeping willow (Salix babylonica). The trees were installed on mounds and were six to nine feet high in 15-gallon pots. At the time of the September 2013 site visit, all of the planted trees appeared to be healthy. It was noted during a subsequent site visit by TRC that an animal had damaged the bark on approximately 50% of the

single stem trees. TRC installed predator guards to help protect the trees from further damage. The installation of these guards was completed during November 2013.

The 2014 wetland mitigation monitoring activities included a spring Site visit by the wetland biologist on May 29 and 30, 2014. The following observations related to the Wetland Area were included in the 2013 Compensatory Mitigation Monitoring Report (Cardno JFNew, 2014).

During the May 2014 site visit, several of the trees planted along the south border of the forested zone appeared to be stressed and/or dying. Two of the river birch trees had already died, and while it is not possible to determine the exact cause, it is likely to be the result of damage that had occurred prior to the installation of the predator guards in 2013.

The 2014 monitoring period satisfied the permit required (NJDEP Permit 1439-04-0001.1) monitoring for the wetland mitigation associated with the previous source reduction and remedial activities. The general status of phytoremediation planting continued to be observed during routine quarterly groundwater and surface water monitoring events performed at the Site.

During the fall of 2016, several trees appeared to have been damaged by human activity. This damage consisted of bent and broken limbs and crowns. Other than these observations, the trees are growing and appear to exhibit no other signs of stress.

Table 3-1
3Q13 Temporary Well Point Sampling Results

| Analytical F | | Benzene ug/l | Ethylbenze ne ug/l | Toluene ug/l | Total Xylenes | bis-2-Ethylhexyl- phthalate (DEHP) ug/l |
|----------------------------|---------------------------------|-----------------|--------------------------|-----------------|---------------|---|
| Solubility | / Limit ⁽¹⁾ | 1700000 | 152000 | 515000 | 175000 | 334 |
| Practical Quantita | tion Limit (PQL) ⁽¹⁾ | 1 | 2 | 1 | 2 | 3 |
| NJGWQS (| Class IIA ⁽¹⁾ | 0.2 | 700 | 600 | 1000 | 2 |
| Higher of NJGW | /QS and PQL ⁽¹⁾ | 1 | 700 | 600 | 1000 | 3 |
| TW-35-1 | 7/31/2013 | <0.50 | <0.50 | <0.50 | <1.5 | 9.9 U |
| TW-35-2 | 8/1/2013 | NMW | NMW | NMW | NMW | NMW |
| TW-35-3 | 8/1/2013 | NMW | NMW | NMW | NMW | NMW |
| TW-35-4 | 8/1/2013 | NMW | NMW | NMW | NMW | NMW |
| TW-35-5 | 7/31/2013 | 29 | 22,000 | 3,200 | 130,000 | 150,000 U |
| TW-35-6 ⁽³⁾ | 8/1/2013 1 | <0.50 | 0.52 | <0.50 | 13 | 790 U |
| TW-35-6F ⁽³⁾⁽⁴⁾ | 8/1/2013 1 | <0.50 | 9.5 | <0.50 | 14 | 1.3 U |
| TW-35-6 ⁽³⁾ | 8/1/2013 2 | <0.50 | <0.50 | <0.50 | 22 | 380 |
| TW-35-6F ⁽³⁾⁽⁴⁾ | 8/1/2013 2 | <0.50 | 14 | <0.50 | 19 | 27 U |
| TW-35-7 | 8/1/2013 | <0.50 | <0.50 | <0.50 | 15 | NS |
| TW-35-8 ⁽³⁾ | 8/1/2013 1 | <0.50 | <0.50 | <0.50 | 130 | 12 U |
| TW-35-8 ⁽³⁾ | 8/1/2013 2 | <0.50 | 200 | <0.50 | 250 | 12 U |

LEGEND

ug/L = micrograms per liter

NS = Not Sampled due to lack of recharge and low sample volumes

NMW = Not Measured due to insufficient purge volume.

F = Filtered

D = Duplicate sample

MDL: Method Detection Limit
PQL: Practical Quantitation Limit

Bold concentrations are above reporting limits but below criteria.

Concentration exceeds NJGWQS

NOTES

- (1) New Jersey Department of Environmental Protection Ground Water Quality Standards (NJGWQS) from NJAC 7:9C GWQS last amended July 22, 2010.
- (2) Temporary wells were driven in between 1 and 3 feet below ground surface. Wells were sampled after equilibration with the surrounding groundwater and removed.
- (3) Multiple samples taken from these wells. First sampling indicated with a "1"; second sampling indicated with a "2".
- (4) Samples were taken at the same time as their counterparts, only bottles for VOCs and DEHP were field-filtered.

Table 3-2 4Q14 Temporary Well Point Sampling Results

| , | I Parameters Jnits | Benzene ug/l | Ethylbenzene ug/l | Toluene ug/l | Total Xylenes | bis-2-Ethylhexyl- phthalate (DEHP) ug/l |
|------------------|-----------------------------------|-----------------|----------------------|-----------------|---------------|---|
| Solubi | lity Limit ⁽¹⁾ | 1700000 | 152000 | 515000 | 175000 | 334 |
| Practical Quanti | tation Limit (PQL) ⁽¹⁾ | 1 | 2 | 1 | 2 | 3 |
| NJGWQ | S Class IIA ⁽¹⁾ | 0.2 | 700 | 600 | 1000 | 2 |
| Higher of NJC | GWQS and PQL ⁽¹⁾ | 1 | 700 | 600 | 1000 | 3 |
| TW-35-1 | - | NMW | NMW | NMW | NMW | NMW |
| TW-35-2 | 11/10/2014 | <0.5 | <0.5 | <0.5 | <1.5 | 9.4 |
| TW-35-2(F) | 11/10/2014 | NA | NA | NA | NA | 1.9 |
| TW-35-3 | 11/10/2014 | <0.5 | <0.5 | <0.5 | <1.5 | 1.3 |
| TW-35-3(F) | 11/10/2014 | NA | NA | NA | NA | <1.0 |
| TW-35-4 | 10/28/2014 | 0.72 | 140 | <0.5 | 270 | NS |
| TW-35-5 | - | NMW | NMW | NMW | NMW | NMW |
| TW-35-6 | - | NMW | NMW | NMW | NMW | NMW |
| TW-35-7 | - | NMW | NMW | NMW | NMW | NMW |
| TW-35-8 | - | NMW | NMW | NMW | NMW | NMW |
| TW-35-9 | 11/13/2014 | <0.5 | <0.5 | <0.5 | <1.5 | <1.0 |
| TW-35-9(F) | 11/14/2014 | <0.50 | 200 | <0.50 | 250 | <1.0 |

LEGEND

ug/L = micrograms per liter

NA = Not Applicable

NMW = Not Measured due to insufficient purge volume.

(F) = Filtered

 $D = Duplicate \ sample$

MDL: Method Detection Limit

PQL: Practical Quantitation Limit

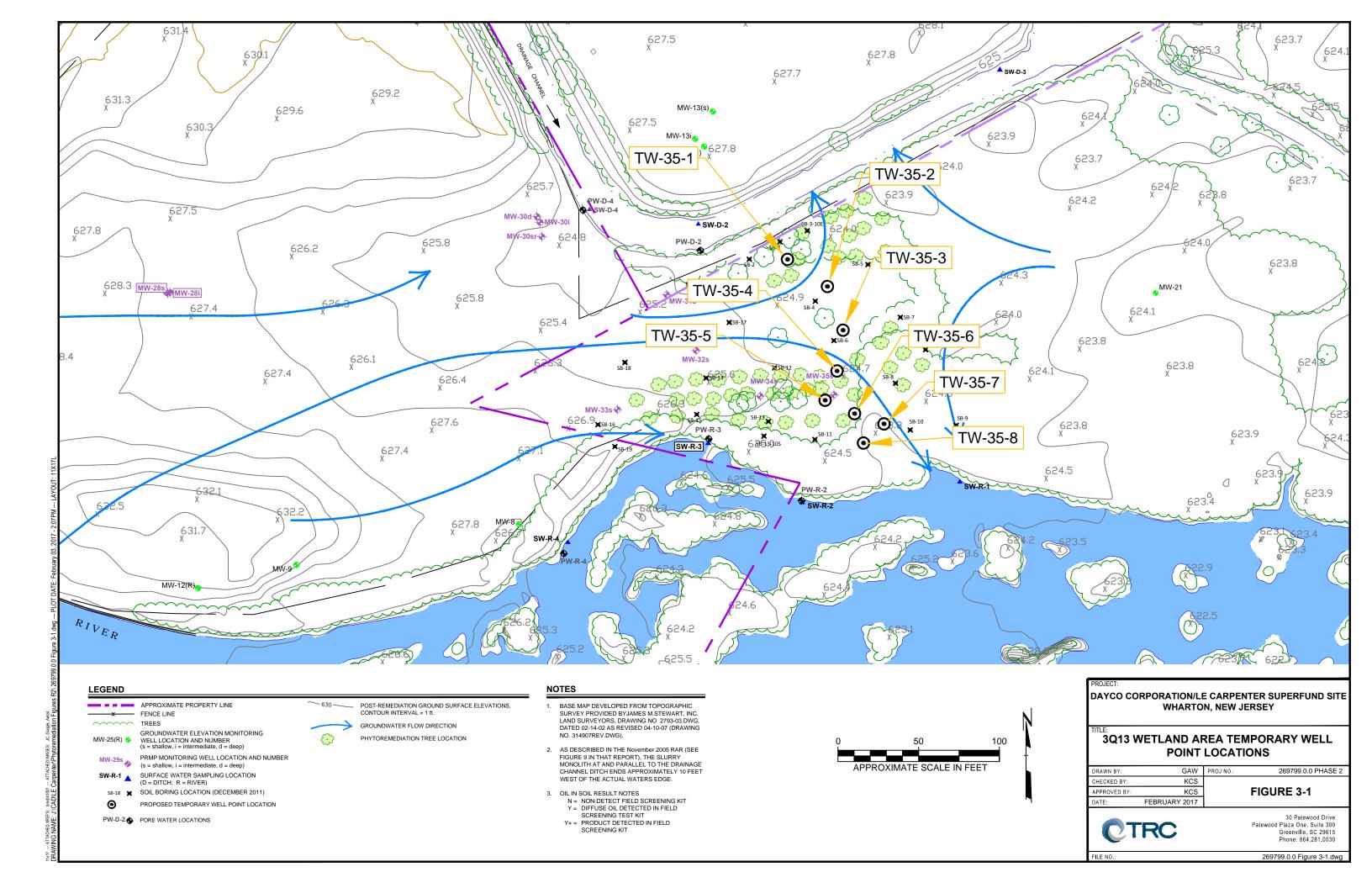
Bold concentrations are above reporting limits but below criteria.

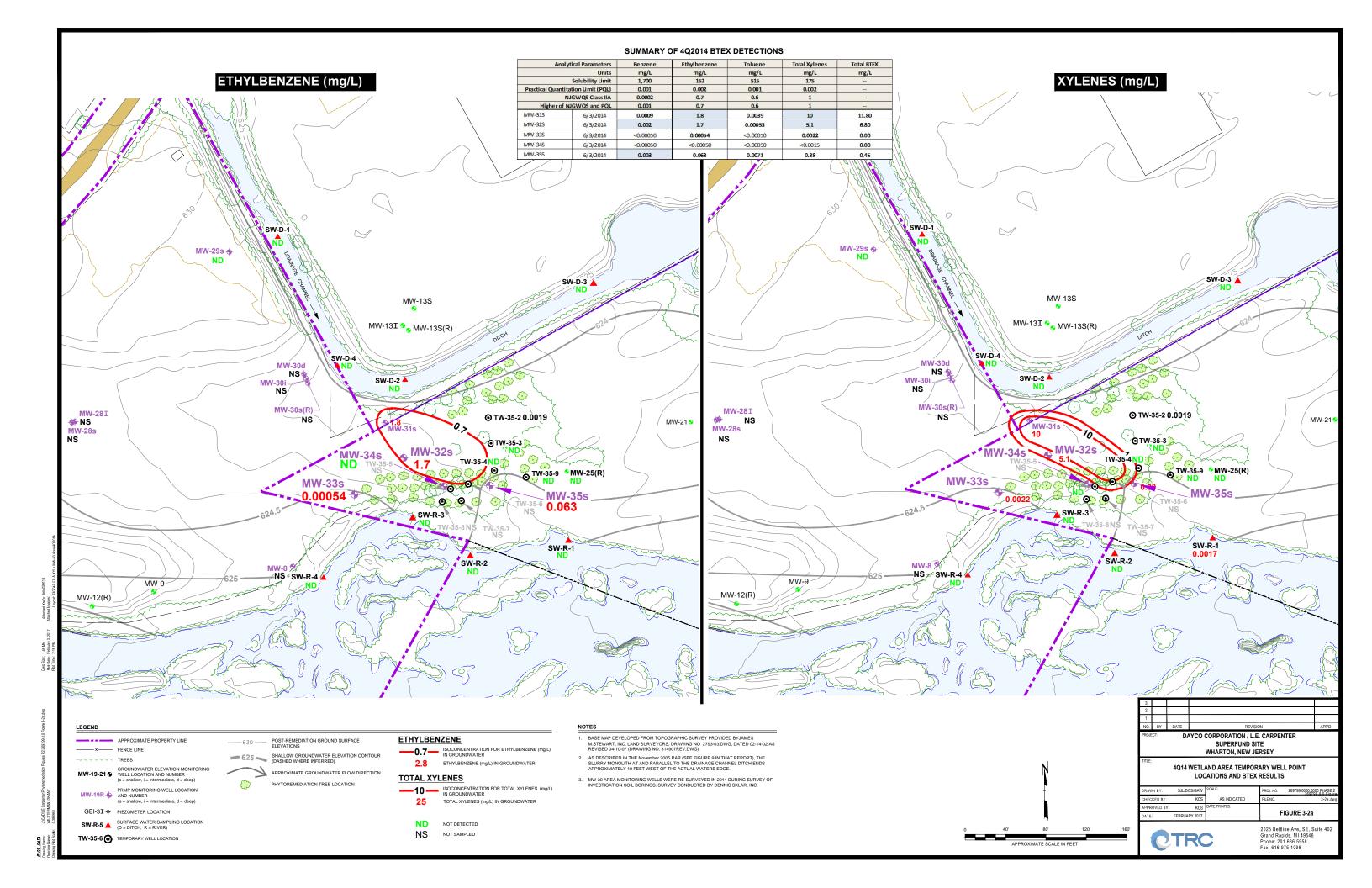
Concentration exceeds NJGWQS

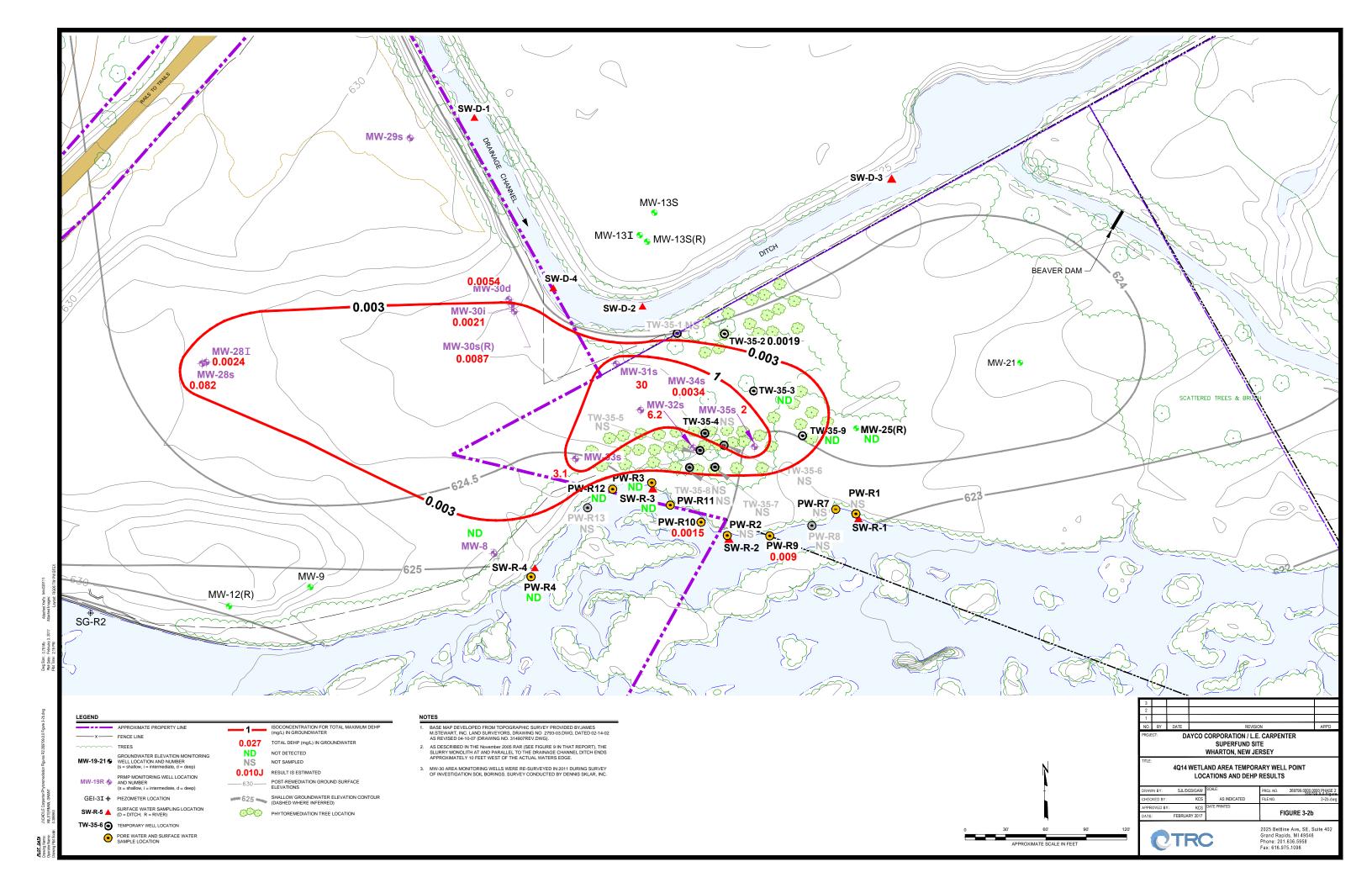
NOTES

(1) New Jersey Department of Environmental Protection Ground Water Quality Standards (NJGWQS) from NJAC 7:9C GWQS last amended July 22, 2010.

(2) Temporary wells were driven in between 1 and 3 feet below ground surface. Wells were sampled after equilibration with the surrounding groundwater and removed.







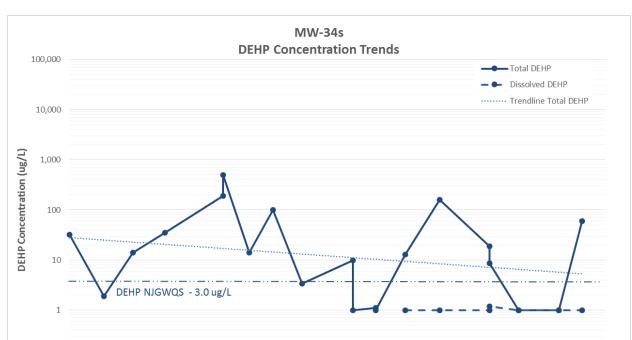
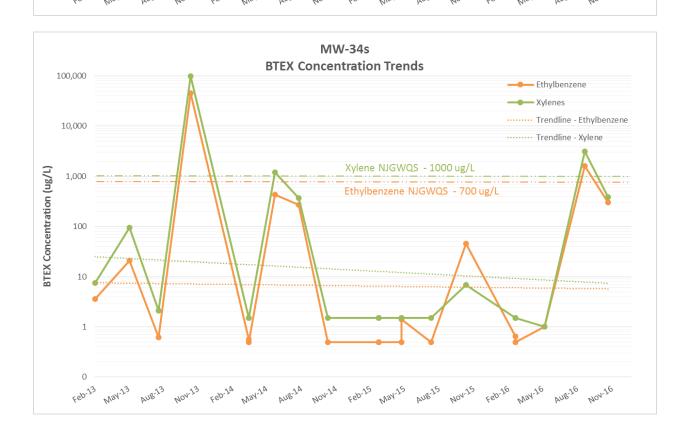


Figure 3-3a Time vs COC Concentrations in Wetland Area Monitoring Well MW-34s



3-11

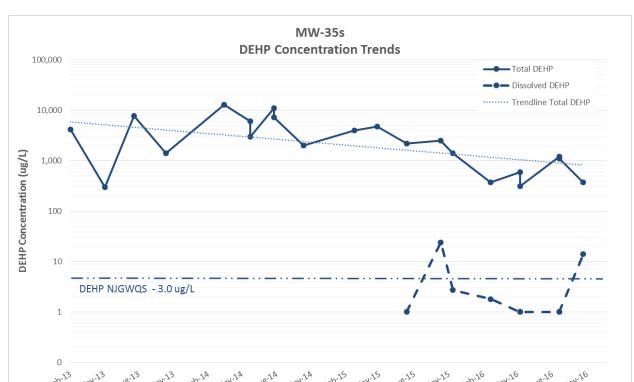
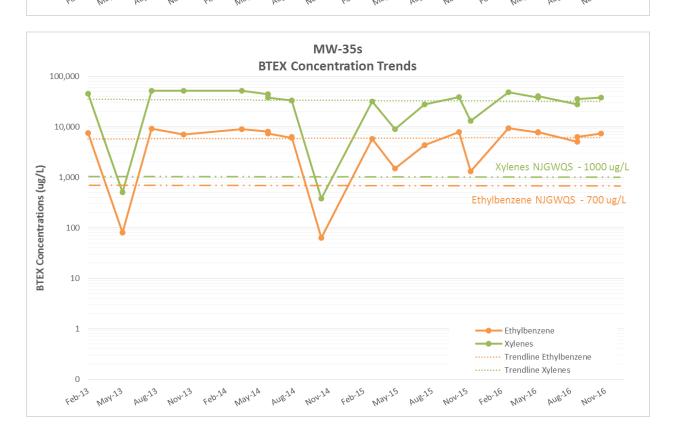
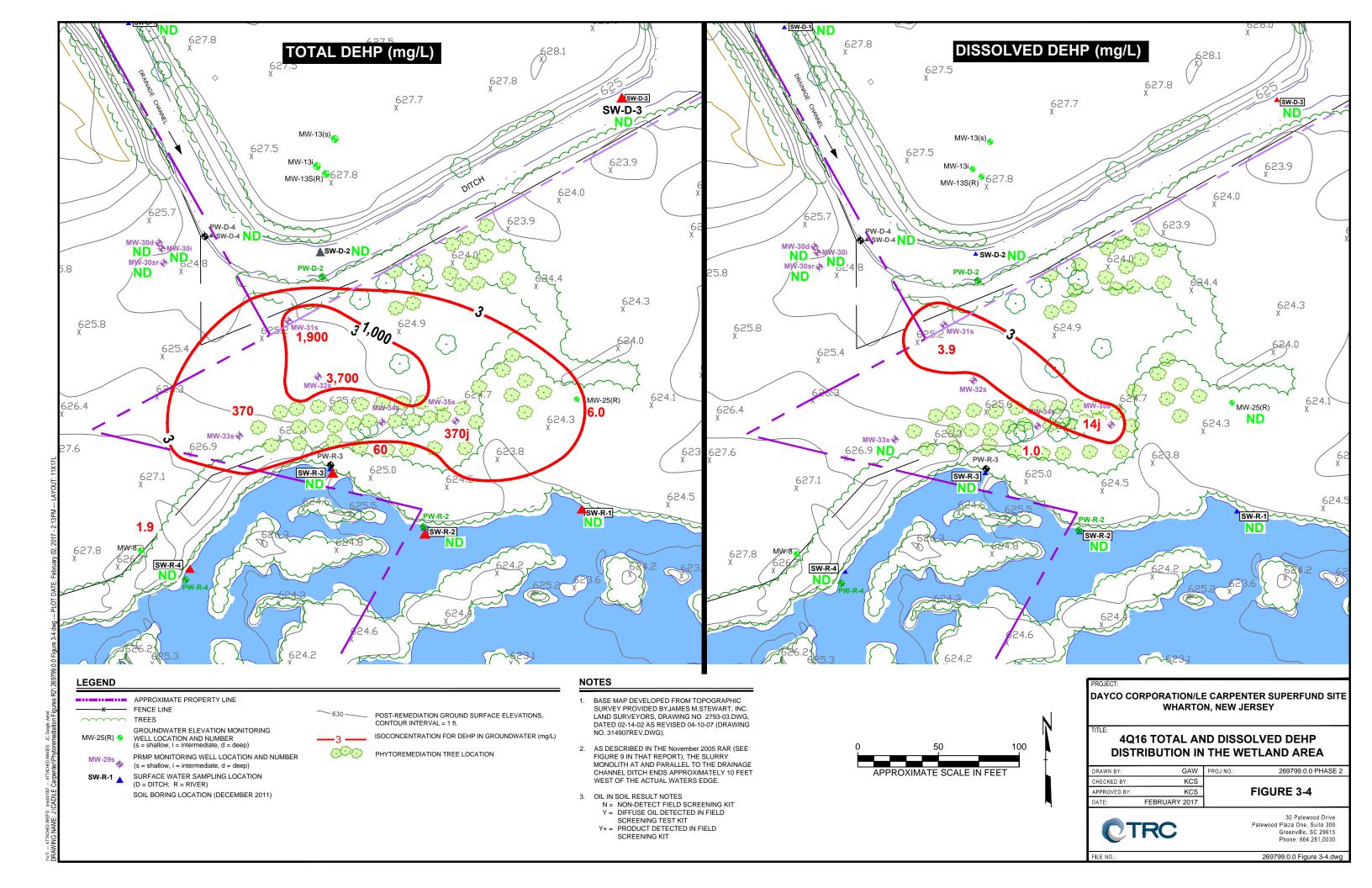


Figure 3-3b Time vs COC Concentrations in Wetland Area Monitoring Well MW-35s





Section 4 Conclusions and Recommendations

This section presents conclusion and recommendations in association with the phytoremediation pilot study installed in the Wetland Area of the Site.

Conclusions

- The unique geological conditions in the Wetland Area, including the presence of a cobble layer and fine grained flood plain soils, presented challenges to installation of the phytoremediation planting and temporary well point samplers.
- The inundated conditions of the wetlands, in conjunction with the unique geology, likewise prevent installation of conventional monitoring wells free of sampling artifacts.
- Notwithstanding the above, the phytoremediation pilot appears to be positively affecting the groundwater quality in terms of reduced total and dissolved concentrations of DEHP and total concentrations of ethylbenzene and xylenes.
- Dissolved DEHP appears to be confined within the phytoremediation pilot footprint.

Recommendations

- Consider replacement and additional phytoremediation plantings in the Wetland Area.
- Continue monitoring for total and dissolved DEHP in Wetland Area monitoring wells.
- Continue to research and evaluate passive/in-situ sampling methodologies that will allow for accurate measurement of DEHP where well point and monitoring well installation is problematic.

Section 5 References

- Cardno JFNew. 2013. 2013 Compensatory Mitigation Monitoring Report for the L.E. Carpenter & Company, Borough of Wharton, Morris County, NJ. Project No. 040229 November 10, 2013.
- Cardno JFNew. 2014. 2014 Compensatory Mitigation Monitoring Report for the L.E. Carpenter & Company, Borough of Wharton, Morris County, NJ. Project No. 040229 November 14, 2014.
- TRC Environmental Corporation. 2013. Progress Report No. 39. Dayco Corporation/L.E. Carpenter Superfund Site, Borough of Wharton, Morris County, New Jersey USEPA ID No. NJD002168748 September 10, 2013.
- TRC Environmental Corporation. 2014. 2013 Second Semiannual Monitoring Report. Dayco Corporation/L.E. Carpenter Superfund Site, Borough of Wharton, Morris County, New Jersey USEPA ID No. NJD002168748 January 2014.
- TRC Environmental Corporation. 2015. 2014 Second Semiannual Monitoring Report. Dayco Corporation/L.E. Carpenter Superfund Site, Borough of Wharton, Morris County, New Jersey USEPA ID No. NJD002168748 January 2015.

Appendix A Agronomic Analytical Reports



Phone: 620.227.7123

800.557.7509 **Fax:** 620.227.2047

1816 E. Wyatt Earp • PO Box 1397 • Dodge City, KS 67801 www.servitechlabs.com

| Lab #: D-2012N | LABORAT | ORY REPORT F | Report Date: 10/02/2012 04:25 pm |
|----------------------------------|--|---------------------|--|
| Send To: 34 Bill To: 36 | TRC ENVIRONMENTAL 2025 E BELTLINE AVE STE 402 GRAND RAPIDS, MI 49546 | | Slan H Jenk - Sean H. Jenkins QA Manager |
| Project ID: | 189291.0000.0000 | Date/Time Received: | 09/14/2012 06:30 am |
| Project Title: | LEC | Name of Submitter: | |
| Sample ID: | MW 32S | Date/Time Sampled: | 09/12/2012 09:42 am |
| Client Name: | TRC Environmental | Name of Sampler: | |
| Subject: | Monitoring Well Lab Analysis | Invoice No: | 355552 |
| Location: | | P.O. #: | 49129 |
| Depth: | | | |

| | Analysis | Result | Unit | lbs / Acre Inch | meq / L |
|-----|-------------------------------------|---------|--------------|--------------------|-------------|
| | Nitrate+Nitrite Nitrogen, NO3+NO2-N | <0.2 | mg/L | <0.0 | <0.0 |
| | Chloride | Pending | mg/L | ٧٥.٥ | ~0.0 |
| | Sulfate | Pending | | | |
| | Sulfate-Sulfur | Pending | | | |
| | Bicarbonate, HCO3 | 430 | mg/L | 97.5 | 7.0 |
| | Carbonate, CO3 | <10 | mg/L | <2.3 | <0.3 |
| | Total Alkalinity, CaCO3 | 350 | mg/L | 79.3 | 7.0 |
| | Hardness (CaCO3) | 340 | mg/L | | |
| | Hardness (CaCO3) | 20 | grains/gal | | |
| | Total Calcium, Ca | 87 | mg/L | 19.7 | 4.3 |
| | Total Magnesium, Mg | 30 | mg/L | 6.8 | 2.5 |
| | Total Potassium, K | 3 | mg/L | 0.7 | <0.1 |
| | Total Sodium, Na | 34 | mg/L | 7.7 | 1.5 |
| | Sodium Adsorption Ratio, SAR | 0.8 | ratio | | |
| | Adjusted SAR, SARa | 2.0 | ratio | | |
| | Sodium Percentage | 17.7 | % of cations | | |
| | Total Boron, B | 0.10 | mg/L | <0.1 | |
| | Total Iron, Fe | 14 | mg/L | 3.2 | |
| | Total Manganese, Mn | 4.9 | mg/L | 1.1 | |
| | Electrical Conductivity, EC | 909 | µmho/cm | | |
| | Total Dissolved Solids (Calc), TDS | 582 | mg/L | | |
| 1 | рН | 6.6 | units | | |
| | рНс | 6.9 | | | |
| Coi | rosion Indices | | | | |
| | Langlier Index, at 20°C | -0.2 | | | |
| | Aggressive Index, Al | 11.7 | | | |
| | | | | | |

PRELIMINARY REPORT: Since one or more analyses have not been completed, the results may be subject to change based on the final report review.

Report formatted for regulatory compliance available upon request.

Page 1 of 2



Phone: 620.227.7123

800.557.7509

Fax: 620.227.2047

Sample ID: MW 32S Client Name: TRC Environmental Location:

Result Notes

1 The sample was received and analyzed outside the regulatory holding time for this analyte.

Interpretations for Corrosive Indices

CORROSIVE: A negative Langlier Index (or Calcium Saturation Index) indicates that the water is corrosive.

AGGRESSIVE INDEX (10.0 to 12.0): Indicates that this water is moderately aggressive and maybe prone to cause corrosion in pipes and metal fixtures.

The Langlier Index and Aggressive Index can be used as indicators of the potential corrosivity of water. Other factors that affect corrosivity may be present and not included in this test.

Interpretations For Irrigation Use

WATER QUALITY RATING - GOOD QUALITY IRRIGATION WATER

SALINITY HAZARD: LOW. May affect growth of very salt sensitive crops.

PERMEABILITY HAZARD: VERY LOW.

BORON HAZARD - NONE: Safe for nearly all crops.

PRELIMINARY REPORT: Since one or more analyses have not been completed, the results may be subject to change based on the final report review.

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Page 2 of 2



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| 816 E. Wyatt Earp • PO Box 1397 • Dodge City, KS 67801

| Lab #: D-2012N | LABORAT LABORAT | ORY REPORT | Report Date: 10/02/2012 04:26 pm |
|----------------------------|--|---------------------|----------------------------------|
| Send To: 34 Bill To: | TRC ENVIRONMENTAL 2025 E BELTLINE AVE STE 402 GRAND RAPIDS, MI 49546 | | Slan H. Jenk. Sean H. Jenkins |
| 36 | | | QA Manager |
| Project ID: | 189291.0000.0000 | Date/Time Received: | 09/14/2012 06:30 am |
| Project Title: | LEC | Name of Submitter: | |
| Sample ID: | MW34S | Date/Time Sampled: | 09/12/2012 09:55 am |
| Client Name: | TRC Environmental | Name of Sampler: | |
| Subject: | Monitoring Well Lab Analysis | Invoice No: | 355552 |
| Location: | | P.O. #: | 49129 |
| Depth: | | | |

| | | | lbs / | |
|-------------------------------------|---------|--------------|-----------|---------|
| Analysis | Result | Unit | Acre Inch | meq / L |
| Nitrate+Nitrite Nitrogen, NO3+NO2-N | <0.2 | mg/L | <0.0 | <0.0 |
| Chloride | Pending | | | |
| Sulfate | Pending | | | |
| Sulfate-Sulfur | Pending | | | |
| Bicarbonate, HCO3 | 290 | mg/L | 65.7 | 4.8 |
| Carbonate, CO3 | <10 | mg/L | <2.3 | < 0.3 |
| Total Alkalinity, CaCO3 | 230 | mg/L | 52.1 | 4.6 |
| Hardness (CaCO3) | 250 | mg/L | | |
| Hardness (CaCO3) | 15 | grains/gal | | |
| Total Calcium, Ca | 67 | mg/L | 15.2 | 3.3 |
| Total Magnesium, Mg | 20 | mg/L | 4.5 | 1.6 |
| Total Potassium, K | 3 | mg/L | 0.7 | <0.1 |
| Total Sodium, Na | 19 | mg/L | 4.3 | 0.8 |
| Sodium Adsorption Ratio, SAR | 0.5 | ratio | | |
| Adjusted SAR, SARa | 1.1 | ratio | | |
| Sodium Percentage | 14.0 | % of cations | | |
| Total Boron, B | 0.08 | mg/L | <0.1 | |
| Total Iron, Fe | 31 | mg/L | 7.0 | |
| Total Manganese, Mn | 3.9 | mg/L | 0.9 | |
| Electrical Conductivity, EC | 747 | µmho/cm | | |
| Total Dissolved Solids (Calc), TDS | 478 | mg/L | | |
| 1 pH | 6.4 | units | | |
| рНс | 7.2 | | | |
| Corrosion Indices | | | | |
| Langlier Index, at 20°C | -0.7 | | | |
| Aggressive Index, AI | 11.2 | | | |

PRELIMINARY REPORT: Since one or more analyses have not been completed, the results may be subject to change based on the final report review.

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Phone: 620.227.7123

800.557.7509

Fax: 620.227.2047

Sample ID: MW34S Client Name: TRC Environmental Location:

Result Notes

1 The sample was received and analyzed outside the regulatory holding time for this analyte.

Interpretations for Corrosive Indices

CORROSIVE: A negative Langlier Index (or Calcium Saturation Index) indicates that the water is corrosive.

AGGRESSIVE INDEX (10.0 to 12.0): Indicates that this water is moderately aggressive and maybe prone to cause corrosion in pipes and metal fixtures.

The Langlier Index and Aggressive Index can be used as indicators of the potential corrosivity of water. Other factors that affect corrosivity may be present and not included in this test.

Interpretations For Irrigation Use

WATER QUALITY RATING - EXCELLENT QUALITY IRRIGATION WATER

SALINITY HAZARD: VERY LOW.

PERMEABILITY HAZARD: VERY LOW.

BORON HAZARD - NONE: Safe for nearly all crops.

PRELIMINARY REPORT: Since one or more analyses have not been completed, the results may be subject to change based on the final report review.

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Phone: 620.227.7123

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1816 E. Wyatt Earp • PO Box 1397 • Dodge City, KS 67801 www.servitechlabs.com

| Lab #: D-2012N | LO06087 LABORAT | ORY REPORT F | Report Date: 10/02/2012 04:26 pm |
|----------------------------------|--|---------------------|--|
| Send To: 34 Bill To: 36 | TRC ENVIRONMENTAL 2025 E BELTLINE AVE STE 402 GRAND RAPIDS, MI 49546 | | Slan H. Jenh. Sean H. Jenkins QA Manager |
| Project ID: | 189291.0000.0000 | Date/Time Received: | 09/14/2012 06:30 am |
| Project Title: | LEC | Name of Submitter: | |
| Sample ID: | MW35S | Date/Time Sampled: | 09/12/2012 10:07 am |
| Client Name: | TRC Environmental | Name of Sampler: | |
| Subject: | Monitoring Well Lab Analysis | Invoice No: | 355552 |
| Location: | | P.O. #: | 49129 |
| Depth: | | | |

| | | | lbs / | |
|-------------------------------------|---------|--------------|-----------|---------|
| Analysis | Result | Unit | Acre Inch | meq / L |
| Nitrate+Nitrite Nitrogen, NO3+NO2-N | <0.2 | mg/L | <0.0 | <0.0 |
| Chloride | Pending | | | |
| Sulfate | Pending | | | |
| Sulfate-Sulfur | Pending | | | |
| Bicarbonate, HCO3 | 320 | mg/L | 72.5 | 5.2 |
| Carbonate, CO3 | <10 | mg/L | <2.3 | < 0.3 |
| Total Alkalinity, CaCO3 | 260 | mg/L | 58.9 | 5.2 |
| Hardness (CaCO3) | 220 | mg/L | | |
| Hardness (CaCO3) | 13 | grains/gal | | |
| Total Calcium, Ca | 55 | mg/L | 12.5 | 2.7 |
| Total Magnesium, Mg | 21 | mg/L | 4.8 | 1.7 |
| Total Potassium, K | 2 | mg/L | 0.5 | <0.1 |
| Total Sodium, Na | 46 | mg/L | 10.4 | 2.0 |
| Sodium Adsorption Ratio, SAR | 1.3 | ratio | | |
| Adjusted SAR, SARa | 2.9 | ratio | | |
| Sodium Percentage | 30.7 | % of cations | | |
| Total Boron, B | 0.09 | mg/L | <0.1 | |
| Total Iron, Fe | 12 | mg/L | 2.7 | |
| Total Manganese, Mn | 1.8 | mg/L | 0.4 | |
| Electrical Conductivity, EC | 729 | µmho/cm | | |
| Total Dissolved Solids (Calc), TDS | 467 | mg/L | | |
| ₁ pH | 6.7 | units | | |
| рНс | 7.2 | | | |
| Corrosion Indices | | | | |
| Langlier Index, at 20°C | -0.4 | | | |
| Aggressive Index, AI | 11.5 | | | |

PRELIMINARY REPORT: Since one or more analyses have not been completed, the results may be subject to change based on the final report review.

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Page 1 of 2



Phone: 620.227.7123

800.557.7509

Fax: 620.227.2047

Sample ID: MW35S Client Name: TRC Environmental Location:

Result Notes

1 The sample was received and analyzed outside the regulatory holding time for this analyte.

Interpretations for Corrosive Indices

CORROSIVE: A negative Langlier Index (or Calcium Saturation Index) indicates that the water is corrosive.

AGGRESSIVE INDEX (10.0 to 12.0): Indicates that this water is moderately aggressive and maybe prone to cause corrosion in pipes and metal fixtures.

The Langlier Index and Aggressive Index can be used as indicators of the potential corrosivity of water. Other factors that affect corrosivity may be present and not included in this test.

Interpretations For Irrigation Use

WATER QUALITY RATING - EXCELLENT QUALITY IRRIGATION WATER

SALINITY HAZARD: VERY LOW.

PERMEABILITY HAZARD: VERY LOW.

BORON HAZARD - NONE: Safe for nearly all crops.

PRELIMINARY REPORT: Since one or more analyses have not been completed, the results may be subject to change based on the final report review.

Report formatted for regulatory compliance available upon request.

Page 2 of 2





October 09, 2012

Ms. Sean Jenkins Servi - Tech Labs PO Box 1397 Dodge City, KS 67801

RE: Project: 34

Pace Project No.: 60130502

Dear Ms. Jenkins:

Enclosed are the analytical results for sample(s) received by the laboratory on October 04, 2012. The results relate only to the samples included in this report. Results reported herein conform to the most current TNI standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Shui Dosenstande
Sherri Rosenstangle

sherri.rosenstangle@pacelabs.com Project Manager

Enclosures







CERTIFICATIONS

Project: 34

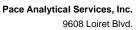
60130502

Pace Project No.:

Kansas Certification IDs

9608 Loiret Boulevard, Lenexa, KS 66219 A2LA Certification #: 2456.01 Arkansas Certification #: 12-019-0 Illinois Certification #: 002885 Iowa Certification #: 118
Kansas/NELAP Certification #: E-10116

Louisiana Certification #: 03055 Nevada Certification #: KS000212008A Oklahoma Certification #: 9205/9935 Texas Certification #: T104704407-12-3 Utah Certification #: KS000212012-2



Lenexa, KS 66219 (913)599-5665



SAMPLE SUMMARY

Project: 34

| Lab ID | Sample ID | Matrix | Date Collected | Date Received | |
|-------------|------------|--------|----------------|----------------|--|
| 60130502001 | 6085 MW32S | Water | 09/12/12 09:42 | 10/04/12 11:10 | |
| 60130502002 | 6086 MW34S | Water | 09/12/12 09:55 | 10/04/12 11:10 | |
| 60130502003 | 6087 MW35S | Water | 09/12/12 10:07 | 10/04/12 11:10 | |





SAMPLE ANALYTE COUNT

Project: 34

| Lab ID | Sample ID | Method | Analysts | Analytes Reported |
|-------------|------------|-----------|----------|----------------------|
| 60130502001 | 6085 MW32S | EPA 300.0 | AJM | 2 |
| 60130502002 | 6086 MW34S | EPA 300.0 | AJM | 2 |
| 60130502003 | 6087 MW35S | EPA 300.0 | AJM | 2 |





ANALYTICAL RESULTS

Project: 34

| Sample: 6085 MW32S | Lab ID: 60° | 130502001 | Collected: 09/12/1 | 2 09:42 | Received: 10 | 0/04/12 11:10 | Matrix: Water | |
|-------------------------|----------------------------|---------------|--------------------|---------|--------------|----------------------------------|---------------|------|
| Parameters | Results | Units | Report Limit | DF | Prepared | Analyzed | CAS No. | Qual |
| 300.0 IC Anions 28 Days | Analytical Me | thod: EPA 300 | 0.0 | | | | | |
| Chloride Sulfate | 87.2 m 3.8 m | • | 10.0 1.0 | 10 1 | | 10/07/12 04:11 10/07/12 14:03 | | |





ANALYTICAL RESULTS

Project:

34

| Sample: 6086 MW34S | Lab ID: 601 | 30502002 | Collected: 09/12/1 | 2 09:55 | Received: 10 | /04/12 11:10 | Matrix: Water | |
|-------------------------|-----------------------------|--------------|--------------------|----------|--------------|----------------------------------|---------------|------|
| Parameters | Results | Units | Report Limit | DF | Prepared | Analyzed | CAS No. | Qual |
| 300.0 IC Anions 28 Days | Analytical Met | hod: EPA 300 | 0.0 | | | | | |
| Chloride Sulfate | 85.3 m 39.2 m | • | 10.0 10.0 | 10 10 | | 10/07/12 04:29 10/07/12 04:29 | | |





ANALYTICAL RESULTS

Project:

34

| Sample: 6087 MW35S | Lab ID: 601 | 30502003 | Collected: 09/12/1 | 2 10:07 | Received: 10 | /04/12 11:10 | Matrix: Water | |
|-------------------------|-----------------------------|-------------|--------------------|---------|--------------|----------------------------------|---------------|------|
| Parameters | Results | Units | Report Limit | DF | Prepared | Analyzed | CAS No. | Qual |
| 300.0 IC Anions 28 Days | Analytical Met | hod: EPA 30 | 0.0 | | | | | |
| Chloride Sulfate | 25.2 m 90.5 m | · · | 2.0 10.0 | 2 10 | | 10/07/12 14:20 10/07/12 04:46 | | |



QUALITY CONTROL DATA

Project:

34

Pace Project No.:

60130502

QC Batch:

WETA/21926

Analysis Method:

EPA 300.0

QC Batch Method:

EPA 300.0

Analysis Description:

300.0 IC Anions

Associated Lab Samples:

60130502001, 60130502002, 60130502003

METHOD BLANK: 1074840

Matrix: Water

Associated Lab Samples:

60130502001, 60130502002, 60130502003

Blank

Reporting

Parameter

Units

Result

Blank

Result

Limit

Qualifiers

Chloride

ND

10/06/12 20:56 1.0

Associated Lab Samples:

mg/L mg/L

ND

1.0 10/06/12 20:56

Analyzed

METHOD BLANK: 1075303

60130502001, 60130502003

Units

Units

Matrix: Water

Reporting Limit

Analyzed

96

99

95

Qualifiers

Chloride Sulfate

Sulfate

mg/L

ND ND

10/07/12 09:42 1.0 1.0 10/07/12 09:42

LABORATORY CONTROL SAMPLE:

Parameter

LABORATORY CONTROL SAMPLE:

Parameter

Parameter

1074841

mg/L

Spike Conc.

Spike

Conc.

LCS Result

4.8

4.9

4.7

4.8

LCS % Rec % Rec Limits

Qualifiers

Chloride Sulfate

mg/L mg/L 5 5

90-110

90-110

1075304

Units

LCS Result

LCS % Rec % Rec Limits

Qualifiers

Chloride Sulfate

mg/L mg/L 5

5

90-110

MATRIX SPIKE SAMPLE:

1074842

Parameter Units Chloride mg/L

MS

Spike

Conc.

250

250

96

MS

MSD

Result

781

303

90-110

mg/L

Units

mg/L

mg/L

60130224022 Result

Spike Conc. 2500

2500

Result 5390

MS % Rec 85 % Rec Limits Qualifiers

Chloride

Sulfate

Sulfate

MATRIX SPIKE & MATRIX SPIKE DUPLICATE:

1074843

1074844

MS

Result

2390

MSD

% Rec

91

93

96

64-118 61-119

60130505001

Result

553

70.8

MSD

Spike

Conc.

3260

ND

771

300

87

92

MS

% Rec

61-119

% Rec Max RPD Qual Limits RPD 64-118 12 1

1

Date: 10/09/2012 04:37 PM

Parameter

REPORT OF LABORATORY ANALYSIS

250

250

Page 8 of 10

10



QUALIFIERS

Project: 34

Pace Project No.: 60130502

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PRL - Pace Reporting Limit.

RL - Reporting Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

Date: 10/09/2012 04:37 PM





QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project:

34

| Lab ID | Sample ID | QC Batch Method | QC Batch | Analytical Method | Analytical Batch |
|-------------|------------|-----------------|------------|-------------------|---------------------|
| 60130502001 | 6085 MW32S | EPA 300.0 | WETA/21926 | | |
| 60130502002 | 6086 MW34S | EPA 300.0 | WETA/21926 | | |
| 60130502003 | 6087 MW35S | EPA 300.0 | WETA/21926 | | |

c-12295

Servi-Tech Laboratories

CHAIN-OF-CUSTODY / ANALYTICAL REQUEST DOCUMENT

1602 Parkwest Drive Hastings, NE 68901

1816 East Wyatt Earp Dodge City, KS 67801

6921 South Bell Amarillo, TX 79109

800-557-7509

| Frequested Due Date: TAT: Subcontract Lab: | Requested Due Date: This is the contract Lab: The laboratory and contractual obligations and may result in a Rush Turnaround Surcharge. Turn Around Time (TAT) in calendar days. Turn Around Time | Pequested Due Date: TIAT: Subcontract Lab: Turn around times less than 14 days subject to laboratory and contractual obligations and may result in a Rush Turnaround Surcharge. Turn Around Time (TAT) in calendar days. San | Prequested Due Date: TART: Subcontract Lab: Coming: The State of | Requested Due Date: Turn around times less than 14 days subject to shopping Coet: result in a Rush Turnaround Surcharge. Turn Around Time (TAT) in calendar days. Preservatives A 9/(2/12 09455 A 9/(2/12 0945 | Requested Due Date: TINT: Subcontract Lab: Subcontract Lab: Carrier: Ca | A Company Company A | Requested Due Date: Turn around times less than 14 days subject to laboratorized table: Turn Around Time (TM) in calendar days. Signification Cost: Requested Amayest Turn Around Time (TM) in calendar days. A Q (12) (2) (2) (2) (2) (2) (2) (2) (2) (2) (| Requested Due Date: Turn acound times less than 14 days subject to laboratory and contractual obligations and may result in a flush Turnisound Surchange. Turn Acound Time (TAT) in calendar days. Turn Acound Time (TAT) in calendar days. And Alaka Continents And Alaka Contractual obligations and may be many and may be made and the state of the case. And Alaka Contractual obligations and may be many and may be made and the state of the case. And Alaka Contractual obligations and may be made and the state of the case of the c |
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Sample Condition Upon Receipt

| Client Nam | e: <u>Ser</u> | vi= | Tec | h Labs | Projec | t#_(00130 | 502 |
|--|---------------|---------|-------------------|-----------------|-------------|-----------------------------|-------|
| | ent []c | | ercial oel Use | ☐Pace ☐Oth | er No | Optional Proj. Due Date: | |
| Custody Seal on Cooler/Box Present: Yes | 5 🗗 1 | ۷o | Seals | s intact: Yes | A No | Proj. Name: | (0/16 |
| Packing Material: Bubble Wrap Bubble | Bags | DF | oam | None Dth | ier | | |
| Thermometer Used: (7-19) / T-194 | Туре | of Ice: | : We | | | on ice, cooling proce | |
| Cooler Temperature: 2.3 | | | | | Date and | Initials of nerson e | |
| Temperature should be above freezing to 6°C | | | | Comments: | contents | 10-4-12 BA | |
| Chain of Custody present: | Yes | □Ŋp | □N/A | 1. | |)¥ | |
| Chain of Custody filled out: | ∰Yes | □No | □N/A | 2. | | | |
| Chain of Custody relinquished: | Yes | □№ | □n/a | 3. | | | |
| Sampler name & signature on COC: | Yes | □No | □n/A | 4. | | | |
| Samples arrived within holding time: | Yes | □No | □N/A | 5. | | | |
| Short Hold Time analyses (<72hr): | □Yes | No | □N⁄A | 6. | | | |
| Rush Turn Around Time requested: | □Yes | No | □n/a | 7. | | | |
| Sufficient volume: | Nyes | □No | □n/a | | | | |
| Correct containers used: | Ves | | □Ņ⁄A | | | | |
| -Pace containers used: | Yes | □No | □N/A | | | | |
| Containers Intact: | Yes | | □n/A | 10 | | | |
| Unpreserved 5035A soils frozen w/in 48hrs? | □Yes | | d _{N/A} | | | | |
| Filtered volume received for dissolved tests | □Yes | | DNA | | | | |
| Sample labels match COC: | Yes | _ | □N/A | | | | |
| -Includes date/time/ID/analyses Matrix: W | | | | 13. | | | |
| All containers needing preservation have been checked. | □Yes | | 6N/A | | | | |
| All containers needing preservation are found to be in compliance with EPA recommendation. | □Yes | | , | 14. | | | |
| Exceptions: VOA, coliform, TOC, O&G, WI-DRO (water), | □Yes | 1 | and the same | Initial when | Lot # of ad | Ided | |
| Trip Blank present: | | | 7 | completed | preservativ | | 167 |
| | ☐Yes [| ∐No | ☑ N/A | 15. | | | |
| Pace Trip Blank lot # (if purchased): | | | -1- | | | | |
| Headspace in VOA vials (>6mm): | □Yes { | □No | MNA | 16. | | | |
| Project sampled in USDA Regulated Area: | □Yes [| Эио | J _{N/A} | 17. List State: | | | -a |
| Client Notification/ Resolution: Copy | COC to CI | | 8 | | | | |
| Person Contacted: | 4 | | Date/l |) / N | Field Data | Required? | Y (N) |
| Comments/ Resolution: | | | Date/ i | ine. | | | |
| | | | | | | | |
| | | | | | | | |
| CAD | | | | | | | |
| Project Manager Review: | | | | | Da | te: 10-5 | 12 |

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers)

Pace Pkg., Page 12 of 12

Appendix B Photographic Log



Client Name:Site Location:Project No.:LE CarpenterWharton, NJ269799.0.0 Phase 2

Photo No. Date
1 3/14/2013

Description

Phytoremediation pilot study area prior to initiation of activity looking west



Photo No. Date
2 3/14/2013

Description

Potted trees (weeping willow and river birch) and Tree Well® sleeves for phytoremediation pilot study





Client Name:
LE Carpenter

Choto No.
Date
3 3/18/2013

Description
Installation of Tree Well® sleeve

| Photo No. | Date |
|-----------|-----------|
| 4 | 3/18/2013 |

Description

Installation of Tree Well® sleeve and aeration tubes





Client Name:Site Location:Project No.:LE CarpenterWharton, NJ269799.0.0 Phase 2

Photo No. Date 5 3/20/2013

DescriptionInstalled Weeping willow



Photo No. Date
6 3/20/2013

DescriptionInstalled River birch





Client Name: Site Location: Project No.:

LE Carpenter Wharton, NJ 269799.0.0 Phase 2

Photo No. Date
7 3/20/2013

Description

Phytoremediation pilot study area adjacent to the Rockaway River looking east. Multiple planting completed. Notice cobble at surface.



Photo No. Date 8 3/20/2013

Description

Phytoremediation pilot study area adjacent to the Rockaway River looking north at MW-32s. Multiple planting completed.





Client Name:Site Location:Project No.:LE CarpenterWharton, NJ269799.0.0 Phase 2

Photo No. Date 9 5/13/2013

Description

Phytoremediation pilot study area along Rockaway River looking east/southeast. Approximately 2 months post installation.



Photo No. Date
10 3/24/2014

Description

Phytoremediation pilot study area along Rockaway River looking east/northeast. Approximately 1 year post installation. Predation sleeves installed to protect young trees.





Client Name: Site Location: Project No.: LE Carpenter Wharton, NJ 269799.0.0 Phase 2

Photo No. Date 11 8/4/2014

Description

Phytoremediation pilot study area along Rockaway River looking south/southeast. Approximately 18 months post installation.



Photo No. Date 5/8/2015 12

Description

Weeping willow approximately 2 years post installation





| | Client Name: | Site Location: | Project No.: |
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| Client Name: | | | Site Location: | Project No.: | |
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| Photo No. | Date | | | | |
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| Description Tree vandalism | | | | | |

| Photo No. | Date | | |
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| 16 | 9/1/2016 | | |

Description

Phytoremediation pilot study area along Rockaway River looking south/southeast.
Approximately 3.5 years post installation.

